EVALUATION OF A PARKING FINDER APPLICATION USING THE USER CENTERED DESIGN (UCD) METHOD

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ABSTRACT

Parking problems in big cities in Indonesia, such as Jakarta, are a concern because they are not only related to inefficient use of fuel and traffic congestion, but also safe parking. Vehicle users still use illegal parking services because the available parking lots are considered inadequate and parking management is inefficient. To overcome this problem, a smart parking system is needed that is effective in finding available parking lots. Currently, there are parking search applications such as Parkiran.id and Parkee that have the main features of finding the nearest parking location, parking reservations, and making parking payments. However, both applications still have shortcomings that provide a poor experience for users, such as the On Street Parking System feature that is often problematic in the Parkiran.id application and the membersip feature that does not work in the Parkee application, and also the digital payment system that is not effective in both applications. Therefore, the User Centered Design (UCD) method is needed to determine user needs for parking search applications. The user experience (UX) evaluation of this parking application will be carried out by involving users, which is done using two methods, namely, the System Usability Scale (SUS) and the User Experience Questionnare (UEQ). Based on the research conducted, the parkee application is superior to the parkiran.id application, and the two applications both received input regarding the lot towards the parking point because the current parking search application only provides directions to the location of the parking lot connected to google maps.

Keywords: *User Experience, User Interface, Parking System, System Usability Scale (SUS), User Experience Questionnare (UEQ)*

1. INTRODUCTION

Parking problems in big cities in Indonesia, such as Jakarta, are not only related to traffic congestion, but also to the availability of safe parking spaces. Although the government has made various efforts to regulate illegal parking, vehicle users still resort to this service due to the lack of available parking spaces and inefficient parking management. In recent years, the number of private car ownership in Jakarta has continued to increase, reaching 3,614,575 units, and motorcycles 17,252,412 units, highlighting the need for an adequate parking system to address congestion, air pollution, and fuel usage.

To solve this problem, an effective smart parking system is needed to find available parking spaces, as smart parking can be a solution to get real-time information and can streamline traffic conditions in the City (Fabusuyi, T., & Hill, V., 2020). Currently, smart parking applications have been implemented in several buildings using sensors in each parking space to detect the presence of vehicles. However, this system is considered less effective because drivers still have to search for available parking spaces manually.

The Jakarta provincial government continues to promote parking digitalization, aiming to benefit all parties. In 2021, the Jakarta provincial government developed an Android-based application called Jakparkir for parking management in the capital, but unfortunately, the application only reached the trial stage.

Parkiran.id and Parkee are parking finder applications that are still operational and have the highest number of downloads according to Google

Playstore reviews in June 2023. Both applications have main features for finding the nearest parking location, making parking reservations, and facilitating parking payments. Parkiran.id has a prominent feature called the On Street Parking System, offering the most strategic parking locations on the roadside, cashless, and contactless. Meanwhile, Parkee has a prominent membership feature offering a subscription system with upfront payment and parking facilities according to the subscription period. However, both applications still have shortcomings that result in a subpar user experience, such as the problematic On Street Parking System feature in Parkiran.id, where users often find their reserved parking spaces occupied by other drivers. Additionally, Parkee users have complained about the time-consuming verification process and unsuccessful membership renewal. Both applications have also been criticized for their ineffective digital payment systems and the lack of features such as searching for empty parking spaces and additional facilities like toilets, rest areas, and electric vehicle charging facilities.

Based on these problems, the User Centered Design (UCD) method is needed to understand user needs for parking locator applications. By collecting user opinions, patterns, and behaviors, the UCD method can help analyze the features that users need in a parking application, and can help users understand the functions in the application (C. K., Cheong et al., 2017). This research will analyze the needs of motorists for smart parking services or applications around Jakarta. Evaluation of the user experience (UX) of this parking application will be carried out by involving users, using two methods namely System Usability Scale (SUS) and User Experience Questionnaire (UEQ). The resulting evaluation is a measurement of the user experience of the Parkee and Parkiran.id parking search applications. The choice of this evaluation method is due to practicality, speed, and cost-effectiveness.

2. LITERATURE STUDY

2.1 Parking Systems

According to Shrestha, A., Shakya, S., & Jourdan, Z. (2017), a parking system is designed and used to regulate and manage the vehicle parking process in a specific area or location. The main purpose of a parking system is to create efficiency in parking space utilization, optimize available parking capacity, enhance user experience, and reduce traffic congestion caused by parking space search. The parking system consists of three elements: parking infrastructure, parking technology, and regulation and management. It can be utilized in various locations such as office buildings, shopping centers, public facilities, public areas, stations, airports, and other places requiring efficient parking management. Commonly used parking system models include vehicle detection, RFID parking, digital payment, centralized parking management, and transportation integration.

The implementation of a good parking system can provide various benefits, including reducing traffic congestion, enhancing parking security, decreasing the time spent searching for parking spaces, improving parking space utilization efficiency, and providing a better user experience (Hameed, T., 2017).

2.2 User Centered Design (UCD)

According to ISO 9241-210 (2019), human-centered design is an approach to designing and developing systems aimed at making interactive systems more useful by focusing on system users and applying human factors/ergonomics and usability knowledge and techniques. Another definition by Nielsen, J., & Budiu, R. (2020) states that user-centered design is an approach in human-computer interaction design that focuses on user needs, characteristics, and experiences. UCD places users as the primary focus throughout the design process, including user understanding, requirement gathering, interaction design, testing, and design iteration.

Wijaya, A. S. (2019) states that User-Centered Design (UCD) is a method in design that focuses on user needs. In the context of Information Systems, User-Centered Design is part of the SDLC (System Development Life Cycle), so the application design developed through UCD will be optimized and focused on end-user needs, allowing the application to meet user needs without requiring users to change their behavior to use the application. To execute UCD effectively, experiments, iterations, and experiences in facing failures are needed. Therefore, there are principles in UCD that can be used as guidelines in implementing UCD, including clearly understanding the user, their tasks, and the environment in which the user operates, designing based on evaluations conducted at each iteration, prioritizing user experience and involving the client in design and creation.

The search results also include research papers and articles related to the evaluation and improvement of user interface design to enhance

user experience in applications. These papers discuss the use of the User Experience Questionnaire (UEQ) and the System Usability Scale (SUS) to measure usability and user experience in mobile applications and websites. Additionally, the search results cover the evaluation of parking space requirements at various university campuses, focusing on the identification of parking space needs and user comfort levels in parking areas.

The User-Centered Design (UCD) focuses on usability, i.e., how well a specific technology suits its purpose and meets the needs and requirements of the targeted users and was standardized in the ISO 9241–210. The six principles of this approach include early and continuous involvement of potential users, understanding of user requirements and the whole user experience, and iterative processes between developers and users.

The process within UCD demands designers to combine investigative elements (e.g., surveys and interviews) and generative elements (e.g., brainstorming) to provide and define user needs. Generally, the UCD process involves iteration, which includes repetition and evaluation at each stage before proceeding to the next process. Figure 1 represents the 4 stages in the UCD process, which are, understanding the user and their tasks, as well as the environment in which the user operates, designing based on evaluations conducted at each iteration, prioritizing user experience, and nvolving the client in design and creation.
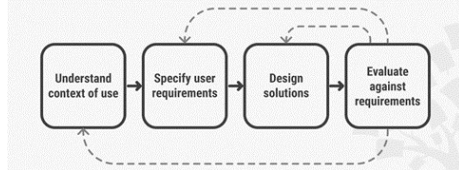

Figure 1: UCD Process

2.3 User Experience

User Experience (UX) is the cognitive impression of an individual in response to a product, system, or service they use or will use (Wang et al., 2020). UX can also refer to the overall user experience from the perspective of perception (emotion and thought), reaction, and behavior that users feel and think through their use of a system, product, content, or service, whether directly or indirectly (Joo, 2017). Therefore, it can be concluded that UX is an impression experienced by users that involves the thoughts, emotions, and behaviors of individuals using a system, product, or service.

UX can also be measured, and the measurement of UX can be used to evaluate a system, where the results of the measurement can provide good recommendations for developing and evaluating the system (Nagalingam & Ibrahim, 2015). With the results of UX measurement, an organization using the system or application can evaluate not only the performance of their system but also the people involved in using the system. In its application, UX measurement will prioritize user opinions using various methods. Figure 2 below explains the indicators of UX measurement according to Jackson (2015):
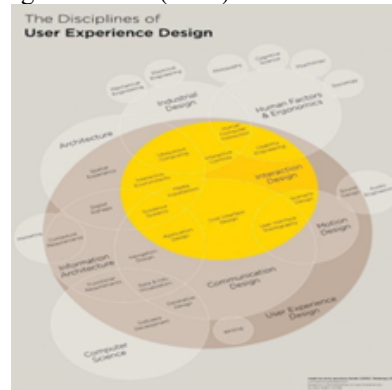

Figure 2: indicators of UX measurement according to Jackson (2015)

According to the above figure, it can be seen that the scope of UX is very broad. UX is not only present in computer science, architecture, human factors and ergonomics, audio, but also in marketing (Jackson, 2015). This means that UX principles can be applied in many fields and can be used for the specific needs of each research, which will be conducted with the aim of knowing the user experience of using a product.

2.4 System Usability Scale (SUS)

SUS is a measurement tool that can be used to measure the level of usability of a system. Formed by John Brooke in 1986, the System Usability Scale can be used to measure the level of usability in various products such as hardware, software, mobile apps, and websites. Some advantages of using the System Usability Scale include:

- Easy to use and accepted by respondents.
- Can be used on small research samples with accurate results.
- Proven to be valid in determining whether a system can be used well.

2.5 User Experience Questionnaire (UEQ)

UEQ is a user experience measurement method that focuses on three main aspects: attractiveness, pragmatic quality, and hedonic quality. These aspects are divided into six measurements: attractiveness, efficiency, clarity, dependability, stimulation, and novelty. The UEQ

questionnaire is simple, easy to understand, and brief, allowing respondents to represent various aspects related to UX measurement. The questionnaire is rated on a 7-point Likert scale with intervals from 1 to 7. The results are then calculated using the UEQ framework, which converts the scale from 1 to 7 into 3 (very poor) to +3 (very good). The average values in each aspect are then grouped back into six UEQ aspects until the average value is obtained.

3. METHODOLOGY

3.1 Framework

The background of the problem will explain an overview of the aspects that will be discussed in this research, of course the aspects that exist in UCD, SUS and UEQ. Then give a little explanation about the parking system and parking applications in Jakarta which will be the object of research.

The second stage is the formulation of the problem to be carried out is to formulate the problem to be studied based on the background of the existing problem. In the third stage, what will be done is to conduct a literature study that will be used in data collection to deepen the material and find out the research that has been done in measuring user experience before. After that, discuss aspects of the methods used for research.

The next stage is to explain the data sources that will be used in the study and also discuss the population, sampling size and type of measurement using SUS and UEQ. For data collection, the results of the research will be carried out by distributing questionnaires first to prospective respondents, in this study prospective respondents are motorists in Jakarta who have used parking services and applications to find out their needs regarding the parking application. After all the questionnaire data has been collected, the UI design of the parking application will be carried out in accordance with the needs of potential users based on the previous questionnaire, as well as data processing using the tools provided by SUS and UEQ using excel and data analysis for the assessment of qualitative data results. The last stage of this research is to draw conclusions from the results of the research which will be in the form of quantitative and qualitative measurements. Discussion of the results is carried out to see the results of the research.

3.2 Data Collection Methods

This research was conducted by providing a questionnaire in which the questionnaire format provided by SUS and UEQ had previously been transferred to Indonesian language mode. This questionnaire will be created using google form and will be distributed to motorists in the Jakarta area through social media such as Whatsapp and Instagram.

3.3 Research Population

This study aims to measure the user experience of using parking applications from the perspective of motorists who have used parking services or applications in the Jakarta area. The research population will refer to the total population of motorists in the Jakarta area.

3.4 Sample Size

The number of motorists who became respondents in this parking search application user experience measurement research was 400 motorists who were motorists who had used parking services or applications in Jakarta and of course acted as users of parking services or applications in Jakarta. The way to calculate the number of samples in this study will use the formula proposed by Slovin, namely (Y Septiani, E Aribbe., 2020).

From the Slovin formula that has been stated previously with an error tolerance level of 5% (Yamane, 1967) and also the total population in Jakarta totaling 20,866,987 motorists (Korlantas Polri. 2023). Then it can be determined that the number of samples that need to be taken by researchers is as follows :

$$n\ 400 \frac{20.866.987}{1 + 20.866.987\left(0.05\right)^2}$$

The results of the calculation using the slovin formula are 400 samples, with these results, it can be seen that the sample size needed to analyze the hypothesis in this study is 400 samples.

3.5 Hypothesis

The hypothesis is a temporary answer to a study that must be proven about its truth. The hypotheses in this descriptive research are as follows :

The first hypothesis is the use of the User Centered Design (UCD) method in parking applications from the perspective of users (riders) the UCD method is able to be a solution to the problem of parking application needs proving that parking applications that use UCD are good parking applications.

The second hypothesis is the results of measuring the use of parking applications designed using the UCD method from the perspective of users (motorists) by measuring aspects of SUS and UEQ on the system have good results (positive answers) proving that parking applications designed

using the UCD method are good parking applications.

The third hypothesis is that the results of measuring the use of parking applications designed using the UCD method from the user's perspective (motorists) by measuring aspects of SUS and UEQ on the system have unfavorable results (negative answers) proving that the parking application designed using the UCD method is a poor parking application.

3.6 Data Analysis

In this study, each question given in the questionnaire has been determined by SUS and UEQ itself in accordance with its own aspects and questions, which then in each aspect will be rated by the respondent. The data from this questionnaire will be processed in accordance with the process of data processing that has been provided by SUS and UEQ for the final result will be in the form of conclusions from the questionnaire and supported by the results of Likert scale calculations on each aspect based on the format provided by SUS and UEQ.

4. RESULT AND DISCUSSION

4.1 Responden Demograpics

After the questionnaire was distributed and data was collected in the form of a link to 400 respondents, a total of 409 respondents were obtained. The respondents in this study are drivers who have used parking services or applications in the vicinity of Jakarta. Figure 3 shows the number of respondents based on the parking finder application used.
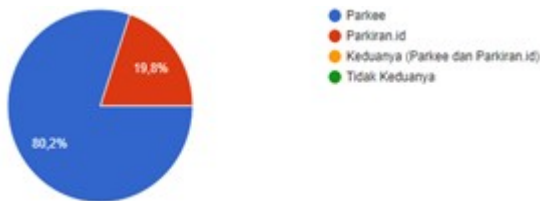

Figure 3: Respondents Based on the Application used

Based on Figure 3, 80.2% of the respondents more frequently use the Parkee application, equivalent to 328 respondents. Meanwhile, 19.8% of the respondents more frequently use the Parkiran.id application, totaling 81 respondents. From this data, it can be concluded that the respondents in this study predominantly use the Parkee application more frequently than the Parkiran.id application. Figure 4 shows the number of respondents based on the type of vehicle used.
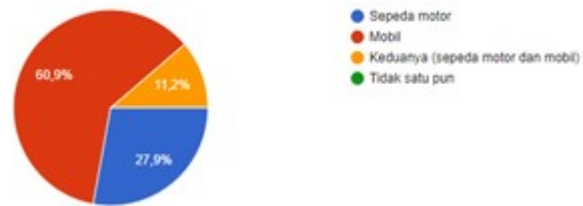

Figure 4: Respondents based on the type of vehicle

Based on Figure 4, 60.9% of the respondents, equivalent to 249 individuals, use cars, 27.9% or 114 respondents use motorcycles, and 11.2% or 46 respondents use both cars and motorcycles when using the parking finder application to search for parking spaces.

4.2 Usability Measurement Results using the System Usability Scale (SUS)

After conducting the questionnaire distribution to drivers in the vicinity of Jakarta, the next step is to input the collected questionnaire data into the SUS tool. Based on the data processing results in the SUS tool, the Parkee application obtained a score of 78, which means the usability score obtained by Parkee is considered "good," while Parkiran.id obtained a score of 56, which means the usability score obtained by Parkiran.id is considered "okay." The classification of these scores can be seen in Figure 5.
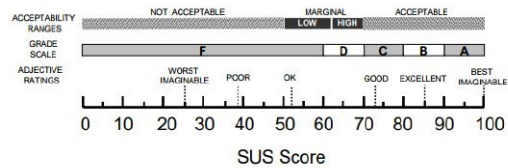

Figure 5: The classification of these scores SUS

4.3 UX Measurement Results using User Experience Questionnaire (UEQ)

After distributing questionnaires to motorists around Jakarta, the next step is to enter the collected questionnaire data in the tool provided by UEQ. The overall results of the UEQ scale for the Parkee and Parkiran.id applications are illustrated in Tables 1 and 2 and in Figures 6 and 7.

The value of each UEQ aspect can be seen in Table 1, where the average on the Attractiveness scale on the parkee application is 1.202; Clarity 0.857; Efficiency 1.101; Accuracy 1.244; Stimulation 1.252; and Novelty 1.208. While the average on the Attractiveness scale on the parkiran.id application is 0.002; Clarity 0.420; Efficiency -0.019; Accuracy 0.278; Stimulation 0.015; and Novelty 0.127.

Table 1: UEQ measurement result scale

UEQ Scales Parkee			UEQ Scales Parkiran.id		
Daya tarik	1,202	0,04	Daya tarik	0,002	0,02
Kejelasan	0,857	0,16	Kejelasan	0,420	0,02
Efisiensi	1,101	0,29	Efisiensi	-0,019	0,07
Ketepatan	1,244	0,06	Ketepatan	0,278	0,03
Stimulasi	1,252	0,00	Stimulasi	0,015	0,02
Kebaruan	1,208	0,03	Kebaruan	0,127	0,02

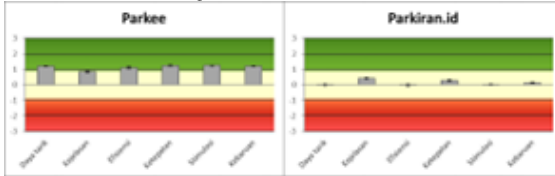In Figure 6 below is a scale graph of the results of the UEQ measurement.

Figure 6: Measurement Results of 6 Aspects of UEQ

Figure 6 above shows a graph of the scale of the results of measuring user experience using 6 aspects of UEQ. The standard of interpretation determined is if the results of the data calculation have a vulnerable value in -0.8 to 0.8, it can be concluded that the results are neutral (standard), if it is more than 0.8, it presents a good evaluation and for those less than -0.8 is a poor evaluation.

UEQ has 6 aspects which then the six aspects are each categorized again into 3 functions. Usability quality is the attractiveness in which it discusses the user's interest in using the system, pragmatic quality is about the accuracy and efficiency of the system and hedonic quality is about design, creativity and novelty. If poured into a graph the results of measurements based on the 6 aspects can be seen in Figure 7.
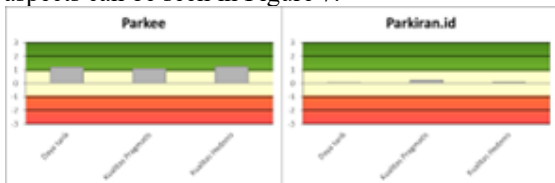

Figure 7: UEQ quality Function Result Graph

While the results in the form of values are in table 2.

Table 2: UEQ quality function result values

Pragmatic and Hedonic Quality Parkee		Pragmatic and Hedonic Quality Parkiran.id	
Daya tarik	1,20	Daya tarik	0,00
Kualitas Pragmatis	1,07	Kualitas Pragmatis	0,23
Kualitas Hedonis	1,23	Kualitas Hedonis	0,07

With the same results as the value of pragmatic quality, the first result graph (Figure 6) explains that in the parkee application the value of accuracy is lower so that it affects the results of pragmatic quality where accuracy is part of pragmatic quality, while the other two factors have good evaluation results, also in accordance with the results of the first measurement. Meanwhile, in the parkiran.id application, the results of pragmatic quality are superior to the other two factors so that

the parkiran.id application can be concluded to have a poor evaluation, also in accordance with the results of the first measurement.

To combine the two evaluations from SUS and UEQ is actually not feasible, as these evaluations have their own aspects in measurement and differ in the form of the final results (SUS is quantitative and UEQ is qualitative). Therefore, it can be concluded that in the research, these two methods are not meant for combining answers, but rather to support and clarify the research results with the respective advantages of each method.

5. CONCLUSION

Based on the results of the research conducted, the user experience of the parking search application using the System Usability Scale (SUS) and User Experience Questionnaire (UEQ) resulted in the conclusion that the Parkee application system has quality categorized as having good performance, while the average score obtained by the Parkiran.id application indicates a fairly good performance.

Usability also has a very important role in the application so that users are more interested and can explore the application and the need to add features that do not yet exist in the application such as searching for empty parking locations and navigating to parking spots so that the application can be used properly and has complete features" is based on the research findings and the identified pain points of users in the parking search application.

The research identified several major pain points for users, such as difficulty in finding parking spots, not knowing if parking is full, forgetting where their vehicle is parked, and concerns about safety and authorization of parking spaces. To address these pain points, the research suggests adding features like searching for empty parking locations, navigating to parking spots, and providing information about authorization and working hours of nearby parking spaces. These features would improve the usability of the application, making it easier for users to find and use parking spaces, and ensuring a complete feature set for the application.

In addition, the research highlights the importance of usability in the application, as it can influence user interest and exploration. By addressing usability concerns and adding features that cater to user needs, the application can become more user-friendly and engaging, potentially increasing user satisfaction and retention.

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